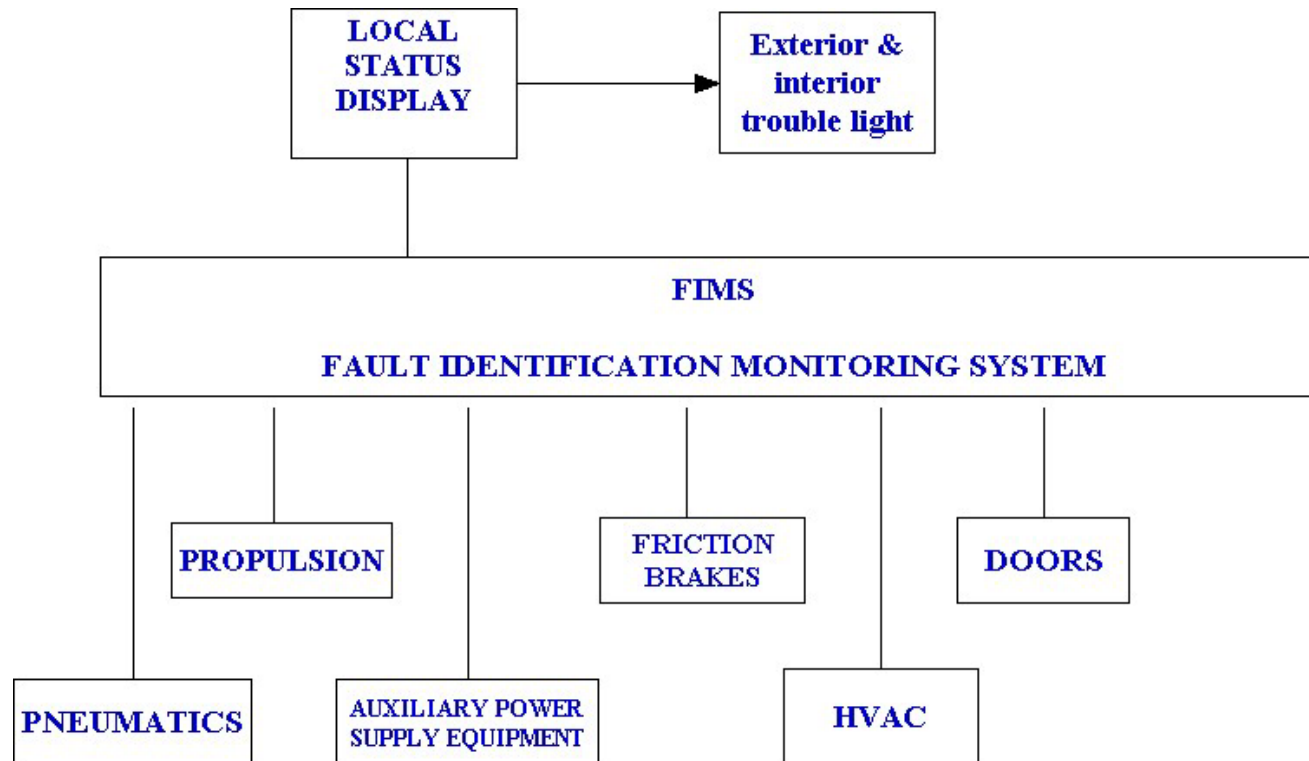# SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT
James R. LaGuardia

Panel 5: Acquiring Data During Routine Operations

Data Collection/Transmission from Various Systems Operating with Microprocessors

LOCAL STATUS DISPLAY	→	Exterior & interior trouble light

FIMS

FAULT IDENTIFICATION MONITORING SYSTEM

PROPULSION FRICTION BRAKES DOORS

PNEUMATICS AUXILIARY POWER SUPPLY EQUIPMENT HVAC

VEHICLE SYSTEMS CONTAINING EVENT AND DATA LOGGERS
DATA TRANSMISSION IS RS232 SERIAL LINK

DATA COLLECTION

The FIMS system will poll each system controller. Depending on the system, the polling will be between 100 milliseconds and 1 second for its current operating status via a serial data link (i.e. friction brakes would be polled more often than the HVAC system) The status polling may be combined with the cross check functions depending on the system being monitored.   Faults will be recorded into the FIMS fault log as well as the system being polled. This data is displayed on a real time display screen on each vehicle.

Data Collection
Continued

System CPU Monitoring

Run time diagnostics: During system operation, the microprocessors constantly monitor the performance of the systems to ensure it is operating properly. Should improper operation occur, annunciation shall take place on the real time display and appropriate action shall be taken by the microprocessors. At this time, any failure will be saved in the EVENT log. Actions by the Maintenance Staff using a laptop can collect additional data by downloading Stream/Data logs from the EVENT logs. The data contains information to aid in troubleshooting and snapshots of vehicle conditions at the time of the fault. Depending on the system, the snapshot capture time varies from 5 to 10 seconds and splits that time between conditions leading up to the fault and conditions immediately following the fault. Data is captured at intervals directly related to the system microprocessor speed.

Data Collection with Maintenance Interaction

A diagnostic interface is provided through the RS-232 port on various system CPU boards that can be connected to the Portable Test Unit (laptop).

- **Requested diagnostics:** Upon request for self-test by maintenance personal, a sequence of tests is executed which test the system more thoroughly than the power-up diagnostics. These tests are not transparent to the operator and proper test set-ups must be done (i.e. vehicle must be at zero speed trainlines must be at specific states, previous tests must have passed, etc.). Should any error that would affect the functionality of the system the operator shall be notified. A test report is available at the end of the testing and can be viewed or saved in Note Pad.

- **Troubleshooting diagnostics:** Troubleshooting diagnostics shall be initialized by maintenance personal through a PTU connected to the microprocessor controller. Maintenance shall have the ability to run all tests automatically or run only selected tests.

  The tests invoked from the PTU will be controlled through dual port RAM. Tests will be requested by the system under test CPU with results reported by the serial controller. The test software will be able to test the following hardware function units of the FIMS:

  - **Smart Serial Communications 80386 RAM and ROM**
  - **Serial data communication links to other subsystems**
  - **Local console communication**
  - **PTU information displayed in English and Engineering Units – All raw data converted before displayed.**

Propulsion Real Time WATCH Screen

Bombardier PTU v2.0.7 - BART A.C. Propulsion - FIMS System/Default

File   Watch/Chart   Diagnostics   Configure   Help

Watch/Evaluate

Speed - Of Vehicle	0	MPH
Load Weight X	59673	lbs
Load Weight X (Raw)	3.541625	V
BRK2 Trainline	Low	---
BRK3 Trainline	Low	---
Direction - Requested	Forward	---
Line Voltage	3.00	V
Line Current	-1.00	A
Link Voltage	17.00	V
Torque Request X	0	ft·lbs
Torque Delivered X	0	ft·lbs
Torque Request Y	0	ft·lbs
Torque Delivered Y	0	ft·lbs
ZSR Control	speed < 2 mph	---
ZSR Feedback	Closed	---
IPA Status - Y	0x20	(Bit Mask)
System Annunciator	No Fault	---
Loss Of Dynamic Brake	No Fault	---
Fault Flag - SPM Faults X - 1	0x0	(Bit Mask)
Control Flags - Engineering	0x0	(Bit Mask)

Chart Recorder

Channel 1	Speed - Of Vehicle
Channel 2	Torque Request X
Channel 3	Torque Delivered X
Channel 4	Torque Request Y
Channel 5	Torque Delivered Y
Channel 6	Link Voltage
Channel 7	Line Current
Channel 8	Line Voltage

○ **Data**   ○ **Zero Output**

○ **Ramp**   ○ **Full Scale**

Data Dictionary

```
---
+12 V Logic Supply
-12 V Logic Supply
A / B Car Logic Id 1
A / B Car Logic Id 2
Air Compressor Fault
```

Software Version: REV023

Car Number: 1272

Self Test (F4)

Event Log (F5)

Logon completed

Exit PTU

F2 - Change Chart Variable F3 - Change Watch Variable

Propulsion Real Time EVENT Screen

Event Logger

Number of Events Logged: 26

Current Event Log

Event Name

Event Name	🕐	1 2	📊
Run Relay Failed	21:13:53	05/06/03	
Low Line Switch Air Pressure	21:13:35	05/06/03	
Direction Mismatch Error	22:31:35	05/05/03	
Direction Mismatch Error	22:31:35	05/05/03	
Dynamic Brake X Failed	22:30:21	05/05/03	
Dynamic Brake Y Failed	22:30:20	05/05/03	
Run Relay Failed	22:30:10	05/05/03	
Run Relay Failed	20:38:27	05/05/03	
Roll Back Lasted Too Long	20:38:22	05/05/03	

Propulsion

Variable Name	Value	Units
Truck ID	Truck X	---
Odometer Mileage	5861.9	mi
Mode Request	Emergency	---
Propulsion System State	Inverter- LS1	---
speed	2.46	MPH
Battery Voltage	27.28	V
Run Relay Drive	Close	---
Run Relay Feedback	Opened	---
Fault Time	1100	mS

Flags   **Save**

History   **Clear**

Select Variables   **Initialize**

Exit   **Save and Clear**

View   Image   Colors   Help

Propulsion Off Line EVENT Log Screen

File   Options   Delete   Help

File : c:\wptu\bapr0307.flg

Time Saved

07:47:58

03-07-2003

Sub System

BART A.C. Propulsion - FIMS

Software version

REV021_2

Sort by
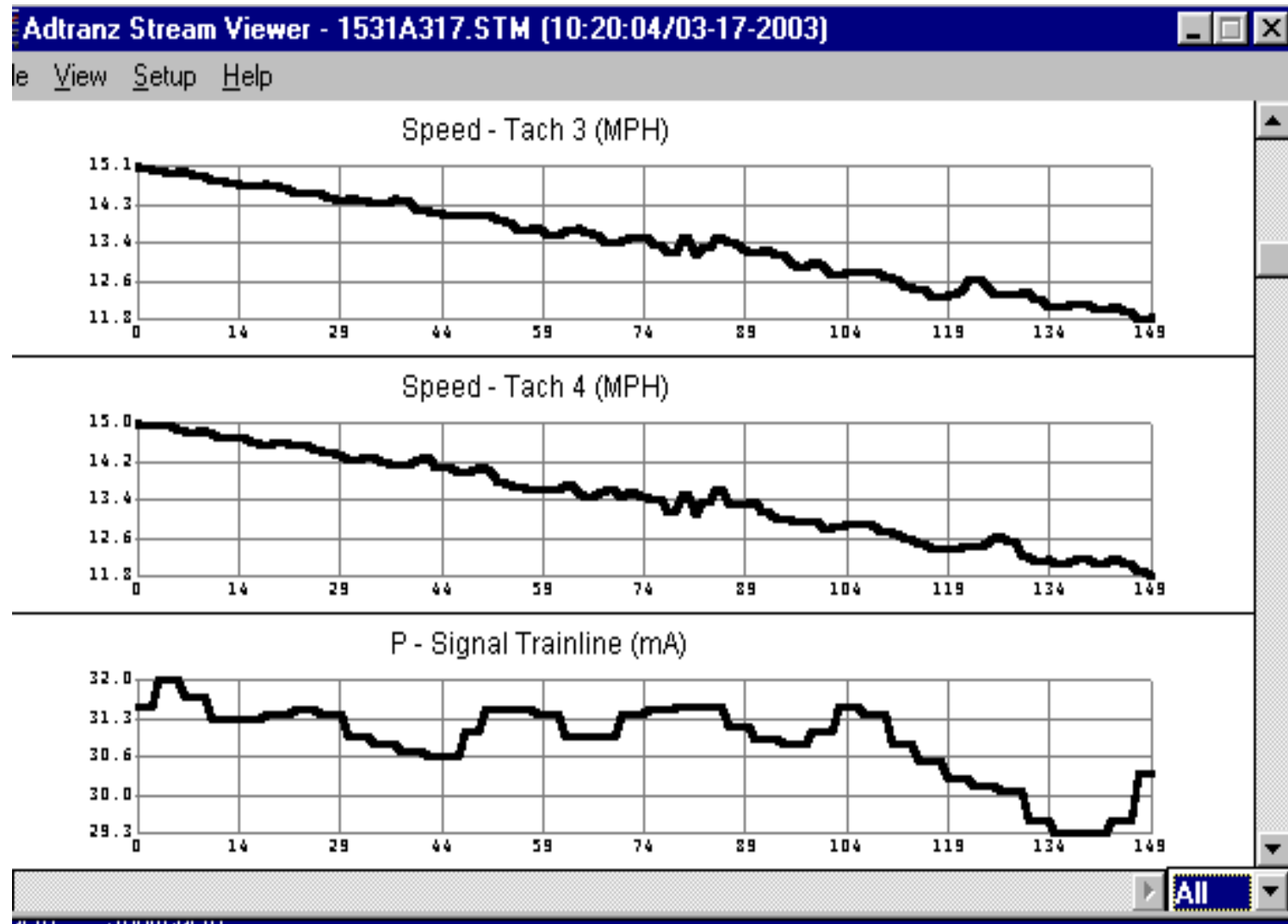
○ Date
○ Car Id
○ Event Name
◉ No Sort

Range

From: ALL

To: ALL

Page Number: 4

Car	Date	Time	Event Type		Variable	Value
1561	02/28/03	14:34:15	Trainline Mismatch - BRK and		Truck ID	Truck X
1561	02/27/03	05:36:47	Trainline Mismatch - BRK and		Odometer Mileage	38111.39 m
1561	02/27/03	05:36:44	Trainline Mismatch - BRK and		Mode Request	Emergency
1561	02/27/03	05:36:42	Trainline Mismatch - BRK and		Propulsion System State	Inverter- LS
1561	02/26/03	23:02:19	Trainline Mismatch - BRK and		speed	38.61 MPH
1561	02/26/03	19:58:22	Link Voltage High In Brake		Battery Voltage	33.83 V
1561	02/26/03	14:50:02	Trainline Mismatch - BRK and		Software Control State	1
1561	02/26/03	14:49:50	Trainline Mismatch - BRK and		Line Voltage	1111.00 V
1561	02/26/03	11:30:49	Link Voltage High In Brake		Link Voltage	2 V
1561	02/24/03	19:40:33	Dynamic Brake X Failed		Inverter Status	5.00
1561	02/24/03	13:14:46	Dynamic Brake X Failed		Truck Cutout	0
1561	02/24/03	13:14:46	Dynamic Brake Y Failed		SPM open dis request	0
1561	02/24/03	13:14:30	Inv. - CC Direction Mismatch		P-signal	0.03 mA
1561	02/24/03	13:14:30	Inv. - CC Direction Mismatch		Dynamic Brake Cutout	0
1561	02/24/03	09:22:18	IPA Y Phase Overcurrent		Initial Brake Request F	1
1561	02/23/03	03:26:32	P-Signal and Yard Signal Out		Motion Faults	0
1561	02/23/03	03:26:29	P-Signal and Yard Signal Out		Motion Faults	638814214
1561	02/23/03	03:26:28	P-Signal and Yard Signal Out		Motion Request	0

Propulsion Stream/Data log Off Line

Data Archiving

- The data retrieved from the vehicle for scheduled and unscheduled Maintenance is saved to a floppy disk and placed into the vehicle maintenance record book. Data Archiving, data is stored on the disks for six months to assist with repeating problems or fleet surveys. Data can also be left in the EVENT logs until it is overwritten (FIFO).

- Data retrieved from vehicles involved in a incident is transmitted to New Vehicle Engineering and Vehicle Maintenance Engineering for review.

- English language with standard Engineering Units.

- Hexadecimal values <u>are not</u> acceptable for information at the primary maintenance level.

<u>Data Presentation</u>

The viewing programs for the EVENT logs reside on the PTUs. Each system supplier has their own format and method of data collection, but all must operate and display in the Windows format. EVENTS can be viewed in real-time or off-line. In real-time mode, the PTU will identify the defective Line Replaceable Unit (LRU). Off-line mode is used to transmit data to other computers not directly connected to the vehicle and can be used by Engineering to evaluate vehicle performance or questions related to particular problem.